Does rotation of B stars depend on metallicity? preliminary results from GIRAFFE spectra

Frédéric Royer[1], Pierre North[2], Claudio Melo[3], Jean-Claude Mermilliod[2], Eva K. Grebel[4], Jose Renan de Medeiros[5], and André Maeder[6]

[1] GEPI / CNRS UMR 8111, Observatoire de Paris, F-92195 MEUDON cedex, France
[2] Laboratoire d'Astrophysique, Ecole Polytechnique Fédérale de Lausanne (EPFL), Observatoire, CH-1290 Sauverny, Switzerland
[3] ESO, Alonso de Cordova 3107, Casilla 19001, Santiago 19, Chile
[4] Astronomisches Institut, Universität Basel, Venusstr. 7, CH-4102 Binningen, Switzerland
[5] Universidade Federal do Rio Grande do Norte, 59072-970 Natal, R.N., Brazil
[6] Observatoire de Genève, CH-1290 Sauverny, Switzerland

Abstract. We show the $v \sin i$ distribution of main sequence B stars in sites of various metallicities, in the absolute magnitude range $-3.34 < M_V < -2.17$. These include Galactic stars in the field measured by [1], members of the h & χ Per open clusters measured by [6], and five fields in the SMC and LMC measured at ESO Paranal with the FLAMES-GIRAFFE spectrograph, within the Geneva-Lausanne guaranteed time. Following the suggestion by [5], we do find a higher rate of rapid rotators in the Magellanic Clouds than in the Galaxy, but the $v \sin i$ distribution is the same in the LMC and in the SMC in spite of their very different metallicities.

1 Introduction, results and conclusion

This work aims at testing the suggestion of [5] that stellar rotation is faster at lower metallicity by direct measurements, especially in the LMC and SMC, on stars with $-3.34 < M_V < -2.17$, i.e. spectral types B0-B6 or masses from ~ 6.7 to 14 $M_\odot$. This work is complementary to that of [4], which deals with slightly more massive stars. The results are shown on Fig. 1 and commented in the caption. There is an excess of slow rotators in the Galaxy relative to the MCs, but the $v \sin i$ distributions of the LMC and the SMC are surprisingly similar.

References

1. H.A. Abt, H. Levato, M. Grosso: ApJ **573**, 359 (2002)
2. N. Cramer: New Astronomy Reviews **43**, 343 (1999)
3. D. Erspamer, P. North: A&A **383**, 227 (2002)
4. S.C. Keller: Pub. Astron. Soc. Australia **21**, 310 (2004)
5. A. Maeder, E. Grebel, J.-C. Mermilliod: A&A **346**, 459 (1999)
6. P. North, F. Royer, C. Melo et al.: 'New homogeneous $v \sin i$ determinations for B stars in galactic open clusters'. In: *Stellar Rotation, IAU Symp. 215*, ed. by A. Maeder and P. Eenens, ASP, p. 69
7. A. Slettebak, G.W. Collins, T.D. Parkinson et al.: ApJS **29**, 137 (1975)
8. J. Southworth, P.F.L. Maxted, B. Smalley: MNRAS **349**, 547 (2004)

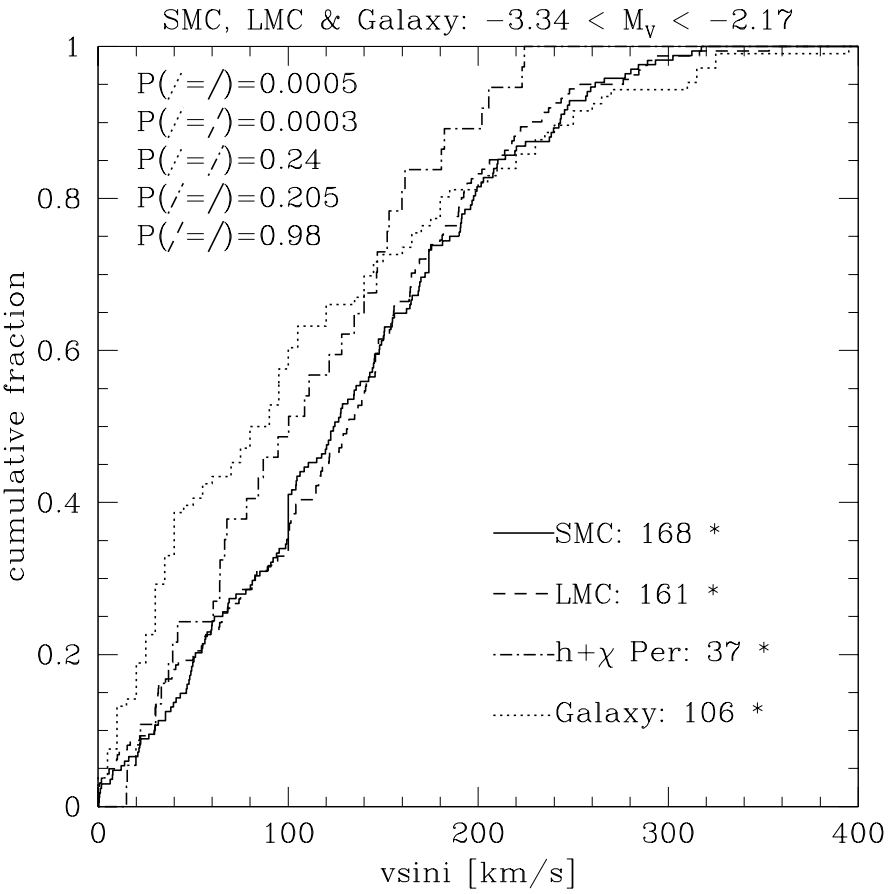

Fig. 1. Cumulative $v \sin i$ distributions for Galactic stars in the field (dotted line), for members of the h & χ Per clusters (dash-dot) and for stars in the LMC (short dash) and in the SMC (solid line). The GIRAFFE spectrograph, attached to the UT2 telescope (VLT) and used in the L2 setup (R = 6400, λ_c = 4272 Å), was used on 3 fields in the LMC (centered on [α_{J2000} =05:31:40,δ_{J2000} =-66:59:48], on [05:30:40, -67:17:12] and on [05:03:48, -69:00:36]) and 2 fields in the SMC (centered on [00:56:12, -72:29:00] and on [00:49:26, -73:12:07]). We fitted synthetic spectra to observed ones in the range $4460 - 4490$ Å with the technique described by [3] using an average $T_{\rm eff} - M_V$ relation for the main sequence and assuming $\log g = 4.0$. The resulting $v \sin i$ values were then transformed to the scale of [7]. For the Galaxy, we defined the $v \sin i$ distribution using 1) the measurements made in the h & χ Per clusters by [6] and 2) the large sample of [1] of bright field B stars, Geneva photometry being used to determine M_V through the calibration of [2]. The SB2 systems were eliminated from this sample, which, although magnitude-limited, does not significantly differ from a volume limited one. The results are summarized in this Figure. Surprisingly, the overall $v \sin i$ distribution is almost exactly the same in the SMC (mean metallicity $Z \sim 0.008$) and in the LMC ($Z \sim 0.004$). There is only a marginal difference between h & χ Per (Z(h Per) ~ 0.01 according to [8]) and the MCs, but a very significant one ($P < 0.1$ %) between the Galactic field ($Z \sim Z_\odot = 0.018$) and the MC fields. Thus, either the metallicity effect saturates for $Z < Z$(LMC) $\sim$ 0.008, or another cause affects rotational velocities, e.g. different rates and orbital parameters of SB1 binaries (not excluded from the samples), through tidal effects.